PATENT CLAIMS

1. Use of a biological photoreceptor as a light-controlled ion channel for the alteration of the ion conductivity of a membrane with the aid of light, wherein the photoreceptor used comprises an apoprotein and a light-sensitive polyene covalently bound to the apoprotein, said polyene interacting with the apoprotein and functioning as a light-sensitive gate.

2. Use according to Claim 1, characterised in that the apoprotein is a transmembrane protein with 5 or more transmembrane helices.

3. Use according to Claim 1 or 2, characterised in that the ion transport system is a proton transport system.

4. Use according to one of Claims 1 to 3, characterised in that the apoprotein is an opsin protein or a derivative or fragment of a naturally occurring opsin protein.

5. Use according to Claim 4, characterised in that the opsin derivative or fragment is the result of an exchange and/or an insertion and/or deletion of one or several amino acid(s) in the natural amino acid sequence of the opsin protein.

6. Use according to one of Claims 1 to 5, characterised in that the amino acid corresponding to the bacteriorhodopsin Asp^{96} is an amino acid other than Asp and in the apoprotein at least 8 of the other 16 amino acids which are involved in the proton transport network in bacteriorhodopsin are identically retained or modified by conservative exchange.

7. Use according to one of Claims 1 to 6, characterised in that at least the amino acids which in bacteriorhodopsin correspond to the amino acids T^{46}, Y^{57}, R^{82}, T^{89}, T^{107}, W^{182}, D^{212} and K^{216} are identically retained at the corresponding position.

8. Use according to one of Claims 1 to 7, characterised in that the apoprotein contains the consensus sequence L(I)DxxxKxxW(F,Y).

9. Use according to one of Claims 1 to 8, characterised in that the apoprotein derives from lower plants.

10. Use according to Claim 9, characterised in that the lower plants are algae.

11. Use according to Claim 10, characterised in that the apoprotein is an opsin protein from *Chlamydomonas reinhardtii.*

12. Use according to one of Claims 1 to 11, characterised in that the apoprotein includes at least the amino acids 61 to 310 of the Channelopsin1 (CHOP-1) according to SEQ ID NO:AF385748 (National Center for Biotechnology Information, NCBI).

13. Use according to one of Claims 1 to 11, characterised in that the apoprotein includes at least the amino acids 24 to 268 of the Channelopsin2 (CHOP-2) according to SEQ ID NO:AF461397.

14. Use according to Claim 13, characterised in that the amino acid histidine at position 134 of the Channelopsin2 according to SEQ ID NO:AF461397 is replaced by another amino acid.

15. Use according to Claim 14, characterised in that the amino acid histidine at position 134 is replaced by arginine.

16. Use according to one of Claims 4 to 8, characterised in that the opsin protein derives from protozoa.

17. Use according to one of Claims 4 to 8, characterised in that the opsin protein derives from bacteria or archaea.

18. Use according to one of Claims 4 to 8, characterised in that the opsin protein derives from fungi.

19. Use according to one of Claims 1 to 18, characterised in that the light-sensitive polyene is a retinal or retinal derivative.

20. Use according to Claim 19, characterised in that the retinal derivative is selected from the following group: 3,4-dehydroretinal, 13-ethylretinal, 9-dm-retinal, 3-hydroxyretinal, 4-hydroxyretinal, naphthylretinal; 3,7,11-trimethyl-dodeca-2,4,6,8,10-pentaenal; 3,7-dimethyl-deca-2,4,6,8-tetraenal; 3,7-dimethyl-octa-2,4,6-trienal; and 6-7 or 8-9 or 10-11 rotation-blocked retinals.

21. Use according to one of Claims 1 to 20 for the light-controlled alteration of the proton conductivity of the membrane.

22. Use according to one of Claims 1 to 20 for the light-controlled alteration of the membrane potential of a cell.

23. Use according to one of Claims 20 to 22, characterised in that the membrane is the cell membrane of a yeast, e.g. *Saccharomyces cerevisiae, Schizosaccharomyces pombe* or *Pichia pastoris*.

24. Use according to one of Claims 20 to 22, characterised in that the membrane is the cell membrane of a mammalian cell or insect cell, e.g. COS, BHK, HEK293, CHO, myeloma cell, MDCK or baculovirus-infected sf9 cell.

25. Use according to one of Claims 20 to 24 for the light-controlled raising or lowering of the intracellular concentration of ions.

26. Use according to Claim 25 for the light-controlled raising or lowering of the intracellular proton concentration.

27. Use according to one of Claims 1 to 20 for the measurement of the intracellular proton concentration directly on the plasma membrane or of a proton concentration gradient across the plasma membrane with the aid of current-voltage curves, wherein the proton concentration gradient can be directly determined from the difference in the current-voltage curves with and without illumination from the reversal potential.

28. Use of a light-controlled ion channel according to one of Claims 1 to 20 for the high throughput screening of biological molecules.

29. Use according to Claim 28 for the high throughput screening of pH-regulated membrane proteins.

30. Use according to Claim 28 for the high throughput screening of voltage-dependent membrane proteins.

31. Use according to one of Claims 20 to 30, characterised in that the light-controlled ion channel is used in combination with a light-controlled active ion transport system.